A Method for USJ Process Control

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ABSTRACT

Ultra-Shallow Junction formation is one of the most challenging areas of semiconductor processing to monitor. Most of the dopant characterization techniques, both electrical and optical, are primarily designed to monitor only one step of doping process: they can be used either to monitor implant induced defect density or to measure activated doping. The presented Surface Photo-Voltage (SPV) - based method [1] is a non-contact mapping technique capable of measuring implanted silicon wafers both before and after electrical activation of doping atoms.

Presented method has been developed for ion implant characterization process and was outlined in several publications [1, 2]. The technique operates in low injection mode and is high frequency modulated. Analysis of the signal allows correlation of the response to critical implant process parameters, such as implant dose, implant energy, beam angle, etc. For annealed wafers, the technique allows calculation of activated doping density averaged over all depletion layers, within the light absorption region.

The important advantage of the method is the capability to measure the multilayer structures. Commonly, to achieve high quality Ultra-Shallow Junction layer IC manufacturers use various pre-conditioning implants, such as Halo or PAI. In the paper we demonstrate the sensitivity of the method to the dopant/implant dose variations in both the source-drain and halo implant regions. The sensitivity of the developed technique to multiple doping layers is due to the electrical connection of these layers and it can be tuned by modifying the excitation light properties. We report measurement results of the single USJ and double implants, including Halo. The measured sensitivity to As^{75}, B^{11} and BF_2 implant doses in Halo and USJ layers varied from 0.8 to 1.2 with the signal repeatability < 0.25% (see Figures 1 and 2).

Key words: Ultra-Shallow Junctions; In-Situ, Real-Time Control and Monitoring; Novel Measurement Methods

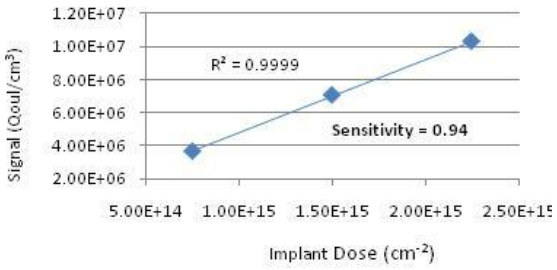

FIGURE 1. Dose Sensitivity to the USJ double implant

FIGURE 2. USJ Measurement repeatability: As + B

REFERENCES

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